

CLAIMS

1. A lithographic projection apparatus comprising:
  - a support structure configured to hold a patterning device, the patterning device configured to pattern a beam of radiation according to a desired pattern;
  - a substrate table configured to hold a substrate;
  - a projection system configured to project the patterned beam onto a target portion of the substrate; and
  - a liquid supply system configured to at least partly fill a space between said projection system and said substrate, with a liquid through which said beam is to be projected, said liquid supply system comprising:
    - a liquid confinement structure extending along at least a part of the boundary of said space, and
    - a seal between said structure and the surface of said substrate.
2. Apparatus according to claim 1, wherein said seal comprises a gas inlet formed in a face of said structure that opposes said substrate to supply gas and a gas outlet formed in a face of said structure that opposes said substrate to extract gas.
3. Apparatus according to claim 2, wherein said gas seal comprises a gas supply to provide gas under pressure to said gas inlet and a vacuum device to extract gas from said gas outlet.
4. Apparatus according to claim 2, wherein said gas inlet is located radially further from the optical axis of said projection system than is said gas outlet.
5. Apparatus according to claim 2, wherein said gas inlet and said gas outlet each comprise a groove in said face of said structure opposing said substrate and a plurality of conduits leading into said groove at spaced locations.
6. Apparatus according to claim 5, wherein said gas inlet and said gas outlet each

comprises a manifold between said conduits and a gas source and a vacuum pump respectively.

7. Apparatus according to claim 1, wherein the gap between said structure and the surface of said substrate inwardly of said gas seal is small so that capillary action at least one of draws liquid into the gap and prevents gas from said gas seal entering said space.
8. Apparatus according to claim 1, wherein said structure forms a closed loop around said space between said projection system and said substrate.
9. Apparatus according to claim 8, wherein said structure has an inner periphery closely conforming to the shape of the image field of said projection system.
10. Apparatus according to claim 1, wherein said substrate table further comprises a cover plate surrounding said substrate, in use, and having an upper surface substantially coplanar therewith.
11. Apparatus according to claim 1, further comprising a controller configured to control the gas pressure in said gas seal to control the stiffness between said structure and said substrate.
12. Apparatus according to claim 1, wherein said structure is stationary relative to said projection system.
13. Apparatus according to claim 1, wherein said support structure and said substrate table are movable in a scanning direction to expose said substrate.
14. Apparatus according to claim 1, wherein said liquid supply system comprises at least one inlet to supply said liquid onto the substrate and at least one outlet to remove said liquid after said liquid has passed under said projection system.

15. Apparatus according to claim 1, wherein said liquid supply system is configured to at least partly fill a space between a final lens of said projection system and said substrate, with said liquid.
16. An immersion lithographic projection apparatus, comprising:  
a support structure configured to hold a patterning device, the patterning device configured to pattern a beam according to a desired pattern;  
a substrate table configured to hold a substrate;  
a projection system configured to project the patterned beam onto a target portion of the substrate; and  
a liquid confinement structure extending along at least part of the boundary of a space bounded by the periphery of a localized area on the surface of said substrate and said surface of said substrate, said space configured to contain a liquid through which said beam is projected and said structure substantially sealing at least part of said space.
17. Apparatus according to claim 16, wherein said support structure and said substrate table are movable in a scanning direction to expose said substrate.
18. Apparatus according to claim 16, wherein said structure comprises at least one inlet to supply said liquid onto the substrate and at least one outlet to remove said liquid after said liquid has passed under said projection system.
19. Apparatus according to claim 16, comprising a gas seal between said structure and said substrate.
20. Apparatus according to claim 19, wherein said gas seal comprises a gas inlet formed in a face of said structure that opposes said substrate to supply gas and a gas outlet formed in a face of said structure that opposes said substrate to extract gas.
21. A device manufacturing method comprising:  
providing a liquid to fill a space between a substrate and a projection system, a

liquid confinement structure extending along at least a part of the boundary of said space;  
forming a gas seal between said structure and the surface of said substrate; and  
projecting a patterned beam of radiation, through said liquid, onto a target portion  
of the substrate.

22. Method according to claim 21, wherein forming said gas seal comprises supplying a gas through a gas inlet formed in a face of said structure that opposes said substrate and extracting gas through a gas outlet formed in a face of said structure that opposes said substrate.

23. Method according to claim 22, comprising supplying said gas at a position radially further from the optical axis of said projection system than said extracting of gas.

24. Method according to claim 21, comprising maintaining the gap between said structure and the surface of said substrate inwardly of said gas seal small so that capillary action at least one of draws liquid into the gap and prevents gas from said gas seal entering said space.

25. Method according to claim 21, wherein said structure forms a closed loop around said space between said projection system and said substrate.

26. Method according to claim 25, wherein said structure has an inner periphery closely conforming to the shape of the image field of said projection system.

27. Method according to claim 21, further comprising controlling the gas pressure in said gas seal to control the stiffness between said structure and said substrate.

28. Method according to claim 21, comprising moving said support structure and said substrate table in a scanning direction to expose said substrate.

29. Method according to claim 21, comprising supplying said liquid onto the substrate

and removing said liquid after said liquid has passed under said projection system.

30. Method according to claim 21, wherein providing a liquid to fill comprises providing a liquid to fill a space between a substrate and a final lens of said projection system.

31. An immersion lithographic projection apparatus comprising:  
a support structure configured to hold a patterning device and movable in a scanning direction, the patterning device configured to pattern a beam of radiation according to a desired pattern;  
a substrate table configured to hold a substrate and movable in a scanning direction;  
a projection system configured to project the patterned beam onto a target portion of the substrate using a scanning exposure;  
a liquid confinement structure that substantially seals at least part of a space bounded by a surface of said substrate and the boundary of a portion of said surface; and  
a liquid inlet to provide a liquid, through which said beam is projected, to said space.

32. Apparatus according to claim 31, wherein said inlet is configured to supply said liquid onto the substrate and comprising an outlet to remove said liquid after said liquid has passed under said projection system.

33. Apparatus according to claim 31, comprising a gas seal between said structure and said surface of said substrate.

34. Apparatus according to claim 33, wherein said gas seal comprises a gas inlet formed in a face of said structure that opposes said surface to supply gas and a gas outlet formed in a face of said structure that opposes said surface to extract gas.

35. Apparatus according to claim 31, wherein said boundary conforms to a shape of

an image field of said projection system.

36. A lithographic projection apparatus comprising:
- a support structure configured to hold a patterning device and movable in a scanning direction, the patterning device configured to pattern a beam of radiation according to a desired pattern;
  - a substrate table configured to hold a substrate and movable in a scanning direction;
  - a projection system configured to project the patterned beam onto a target portion of the substrate using a scanning exposure;
  - a liquid confinement structure having an aperture having a cross-sectional area smaller than a surface area of said substrate;
  - a seal between said structure and said substrate; and
  - a liquid inlet to provide a liquid, through which said beam is projected, to said aperture.
37. Apparatus according to claim 36, wherein said inlet is configured to supply said liquid onto the substrate and comprising an outlet to remove said liquid after said liquid has passed under said projection system.
38. Apparatus according to claim 36, wherein said seal is a gas seal.
39. Apparatus according to claim 38, wherein said gas seal comprises a gas inlet formed in a face of said structure that opposes a surface of said substrate to supply gas and a gas outlet formed in a face of said structure that opposes said surface of said substrate to extract gas.
40. Apparatus according to claim 36, wherein said aperture has a periphery conforming to a shape of an image field of said projection system.
41. An immersion lithographic projection apparatus comprising:

a support structure configured to hold a patterning device, the patterning device configured to pattern a beam of radiation according to a desired pattern;

a substrate table configured to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate;

a liquid confinement structure that can substantially confine all of a liquid provided to an area of a radiation-sensitive surface of said substrate under said projection system, said area being smaller than the entire area of said substrate surface; and

a liquid inlet to provide a liquid to said area and between said projection system and said substrate surface.

42. Apparatus according to claim 41, wherein said support structure and said substrate table are movable in a scanning direction to expose said substrate.

43. Apparatus according to claim 42, wherein said inlet is configured to supply said liquid to said substrate surface and comprising an outlet to remove said liquid after said liquid has passed under said projection system.

44. Apparatus according to claim 43, wherein said inlet supplies said liquid at a first side of said projection system and said outlet removes said liquid at a second side of said projection system as said substrate is moved under said projection system in a direction from the first side to the second side.

45. Apparatus according to claim 41, wherein said structure comprises a gas seal.

46. Apparatus according to claim 45, wherein said gas seal comprises a gas inlet formed in a face of said structure that opposes said substrate surface and a gas outlet formed in a face of said structure that opposes said substrate surface.

47. Apparatus according to claim 41, wherein said area has a periphery conforming to a shape of an image field of said projection system.